MILITARY SPECIFICATION

SEMICONDUCTOR DEVICE, TRANSISTOR, PNP, SILICON, LOW-POWER
TYPE 2N1118

This specification is mandatory for use by all Departments and Agencies of the Department of Defense.

1. SCOPE

1.1 Scope. This specification covers the detail requirements for a PNP, silicon, low-power transistor used in chopper, audio, and RF amplifier circuitry.

1.2 Physical dimensions. See figure 1 (TO-5).

1.3 Maximum ratings.

P_T 1/	V_{CBO}	V_{EBO}	V_{RT}	T_A
mW	Vdc	Vdc	Vdc	°C
150	-25	-20	-25	-65 to +140

1/ Derate linearly 1.31 mW/°C for $T_A > 25°$ C.

1.4 Primary electrical characteristics.

Limits	C_{obo} V_{CB} = -6 Vdc I_E = 0 100 kHz ≤ f ≤ 1 MHz	h_{fe} V_{CB} = -6 Vdc I_E = 1 mAdc	f_{max} V_{CB} = -6 Vdc I_E = 1 mAdc	V_{EC} (ofs) I_B = -1 mAdc I_E = 0
	pf		MHz	mVdc
Min	---	15	8	---
Max	9	---	---	5

2. APPLICABLE DOCUMENTS

2.1 The following documents, of the issue in effect on date of invitation for bids or request for proposal, form a part of the specification to the extent specified herein.

SPECIFICATION

MILITARY

MIL-S-19500 - Semiconductor Devices, General Specification for.

STANDARD

MILITARY

MIL-STD-750 - Test Methods for Semiconductor Devices.

(Copies of specifications, standards, drawings, and publications required by suppliers in connection with specific procurement functions should be obtained from the procuring activity or as directed by the contracting officer.)

3. REQUIREMENTS

3.1 General. Requirements shall be in accordance with MIL-S-19500, and as specified herein.

3.2 Abbreviations, symbols, and definitions. The abbreviations, symbols, and definitions used herein are defined in MIL-S-19500, and as follows:

$V_{EC}(ofs)$ - - - - - - Emitter to collector offset voltage, i.e., open-circuit voltage between emitter and collector when the base-collector junction is forward-biased.
$r_b'C_c$ - - - - - - - - Collector-base time constant

3.3 Design, construction, and physical dimensions. Transistors shall be of the design, construction, and physical dimensions shown on figure 1.

3.3.1 Terminal-lead length. Terminal-lead length(s) other than that specified in figure 1 may be furnished when so stipulated under contract or order (see 6.2) where the devices covered herein are required directly for particular equipment-circuit installation or for automatic-assembly-technique programs. Where other lead lengths are required and provided, it shall not be construed as adversely affecting the qualified-product status of the device, or applicable JAN marking.

3.4 Performance characteristics. Performance characteristics shall be as specified in tables I, II, and III.

3.5 Marking. The following marking specified in MIL-S-19500 may be omitted from the body of the transistor at the option of the manufacturer:

(a) Country of origin.
(b) Manufacturer's identification.

4. QUALITY ASSURANCE PROVISIONS

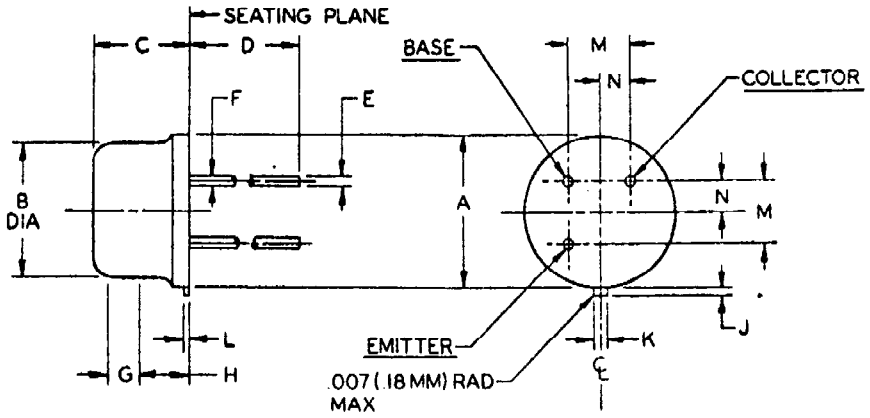
4.1 Sampling and inspection. Sampling and inspection shall be in accordance with MIL-S-19500, and as specified herein.

4.2 Qualification inspection. Qualification inspection shall consist of the examinations and tests specified in tables I, II, and III.

4.3 Quality conformance inspection. Quality conformance inspection shall consist of group A, B, and C inspections.

4.3.1 Group A inspection. Group A inspection shall consist of the examinations and tests specified in table I.

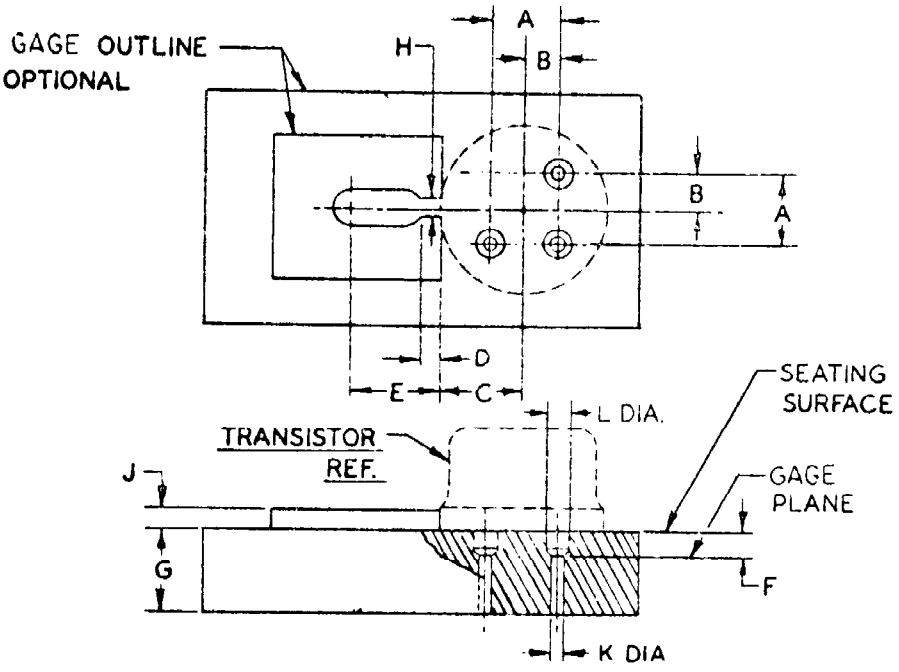
4.3.2 Group B inspection. Group B inspection shall consist of the examinations and tests specified in table II.



LTR	DIMENSIONS				NOTES
	INCHES		MILLIMETERS		
	MIN	MAX	MIN	MAX	
A	.335	.370	8.51	9.40	--
B	.305	.335	7.75	8.51	--
C	.240	.260	6.10	6.60	--
D	1.500	1.750	38.10	44.45	9
E	.016	.021	.41	.53	2,9
F	.016	.019	.41	.48	3,9
G	.100	---	2.54	---	4
H	---	---	---	---	5
J	.029	.045	.74	1.14	8
K	.028	.034	.71	.86	--
L	.009	.125	.23	3.18	--
M	.1414 Nom		3.59 Nom		6
N	.0707 Nom		1.80 Nom		6

NOTES:
1. Metric equivalents (to the nearest .01 mm) are given for general information only and are based upon 1 inch = 25.4 mm.
2. Measured in the zone beyond .250 (6.35 mm) from the seating plane.
3. Measured in the zone .050 (1.27 mm) and .250 (6.35 mm) from the seating plane.
4. Variations on dimension B in this zone shall not exceed .010 (.25 mm).
5. Outline in this zone is not controlled.
6. When measured in a gaging plane .054 +.001, -.000 (1.37 +.03, -.00 mm) below the seating plane of the transistor maximum diameter leads shall be within .007 (.18 mm) of their true location relative to a maximum width tab. Smaller diameter leads shall fall within the outline of the maximum diameter lead tolerance. Figure 2 shows the preferred measured method.
7. All leads shall be electrically insulated from the case.
8. Measured from the maximum diameter of the actual device.
9. All 3 leads.

FIGURE 1. Physical dimensions of transistor type 2N1118 (TO-5).



NOTES:

1. The following gaging procedure shall be used: The use of a pin straightener prior to insertion in the gage is permissible. The device being measured shall be inserted until its seating plane is .125±.010 (3.18±.25 mm) from the seating surface of the gage. A spacer may be used to obtain the .125 (3.18 mm) distance from the gage seat prior to force application. A force of 8 oz ±.5 oz shall then be applied parallel and symmetrical to the device's cylindrical axis. When examined visually after the force application (the force need not be removed) the seating plane of the device shall be seated against the gage.
2. The location of the tab locator, within the limits of dimension C, will be determined by the tab and flange dimension of the device being checked.
3. Metric equivalents (to the nearest .01 mm) are given for general information only and are based upon 1 inch = 25.4 mm.

DIMENSIONS				
LTR	INCHES		MILLIMETERS	
	MIN	MAX	MIN	MAX
A	.1409	.1419	3.58	3.60
B	.0702	.0712	1.78	1.81
C	.182	.199	4.62	5.05
D	.009	.011	.23	.28
E	.125 Nom		3.18 Nom	
F	.054	.055	1.37	1.40
G	.372	.378	9.45	9.60
H	.0350	.0355	.89	.90
J	.150 Nom		3.81 Nom	
K	.0325	.0335	.83	.85
L	.0595	.0605	1.51	1.54

FIGURE 2. Gage for lead and tab location for transistor type 2N1118.

4.3.3 Group C inspection. Group C inspection shall consist of the examinations and tests specified in table III. This inspection shall be conducted on the initial lot and thereafter every 6 months during production.

4.3.4 Group B and group C life-test samples. Samples that have been subjected to group B, 340-hours life-test, may be continued on test to 1,000 hours in order to satisfy group C life-test requirements. These samples shall be predesignated, and shall remain subjected to the group C 1,000-hour acceptance evaluation after they have passed the group B, 340-hour acceptance criteria. The cumulative total of failures found during 340-hour test and during the subsequent interval up to 1,000 hours shall be computed for 1,000-hour acceptance criteria.

4.4 Methods of examination and test. Methods of examination and test shall be as specified in tables I, II, and III, and as follows:

4.4.1 Emitter to collector offset voltage. The transistor shall be tested in the circuit of figure 3. The base current shall be adjusted to the specified value. The voltage between the emitter and collector shall then be measured using a voltmeter with an input impedance high enough that halving it does not change the measured value within the required accuracy of the measurement.

4.4.2 Voltage, reach-through, collector to emitter. An adequate forward dc current shall be applied to the emitter terminal, and a reverse dc voltage shall be applied between collector and base, starting at zero and increasing until the emitter-to-base voltage has reached the specified reverse value. The dc voltage between the collector and the base terminals shall then be measured. The V_{RT} will be equal to the reverse collector-to-base dc voltage less the reverse emitter-to-base dc voltage.

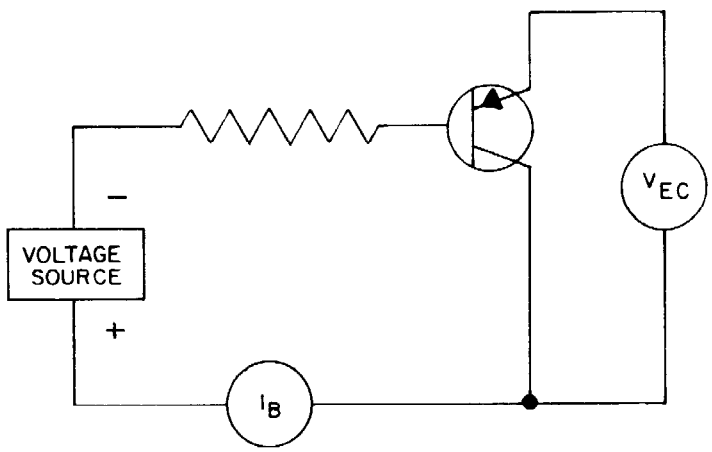


FIGURE 3. Emitter to collector offset voltage test circuit.

TABLE I. Group A inspection.

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
Subgroup 1			10				
Visual and mechanical examination	2071			---	---	---	---
Subgroup 2			7				
Breakdown voltage, collector to base	3001	Bias cond. D; I_C = -1 μAdc		BV_{CBO}	-25	---	Vdc
Breakdown voltage, emitter to base	3026	Bias cond. D; I_E = -1 μAdc		BV_{EBO}	-20	---	Vdc
Collector to base cutoff current	3036	Bias cond. D; V_{CB} = -10 Vdc		I_{CBO}	---	-0.1	μAdc
Collector to base cutoff current	3036	Bias cond. D; V_{CB} = -25 Vdc		I_{CBO}	---	-1.0	μAdc
Emitter to base cutoff current	3061	Bias cond. D; V_{EB} = -10 Vdc		I_{EBO}	---	-0.1	μAdc
Reach through voltage	---	V_{EB} = -1 Vdc (see 4.4.2)		V_{RT}	-25	---	Vdc
Emitter to collector offset voltage	---	I_B = -1 mAdc; I_E = 0 (see 4.4.1 and figure 3)		V_{EC} (ofs)	---	5	mVdc
Small-signal short-circuit forward-current transfer ratio	3206	V_{CB} = -6 Vdc I_E = 1 mAdc		h_{fe}	15	---	---
Subgroup 3			10				
Collector-base time constant	---	V_{CB} = -6 Vdc; I_E = 1 mAdc (see figure 4)		$r_b'C_c$	---	5,000	psec
Open circuit output capacitance	3236	V_{CB} = -6 Vdc; I_E = 0; 100 kHz≤f≤1 MHz		C_{obo}	---	9	pf
Small-signal short-circuit input impedance	3201	V_{CB} = -6 Vdc; I_E = 1 mAdc		h_{ib}	---	90	ohms
Small-signal open-circuit output admittance	3216	V_{CB} = -6 Vdc; I_E = 1 mAdc		h_{ob}	---	2.5	μmhos
Maximum frequency of oscillation	3311	V_{CB} = -6 Vdc; I_E = 1 mAdc (see figure 5)		f_{max}	8	---	MHz
Subgroup 4			15				
High-temperature operation:		T_A = +125° C					
Collector to base cutoff current	3036	Bias cond. D; V_{CB} = -25 Vdc		I_{CBO}	---	-25	μAdc
Low-temperature operation:		T_A = -55° C					
Small-signal short-circuit forward-current transfer ratio	3206	V_{CB} = -6 Vdc; I_E = 1 mAdc		h_{fe}	10	---	---

TABLE II. Group B inspection.

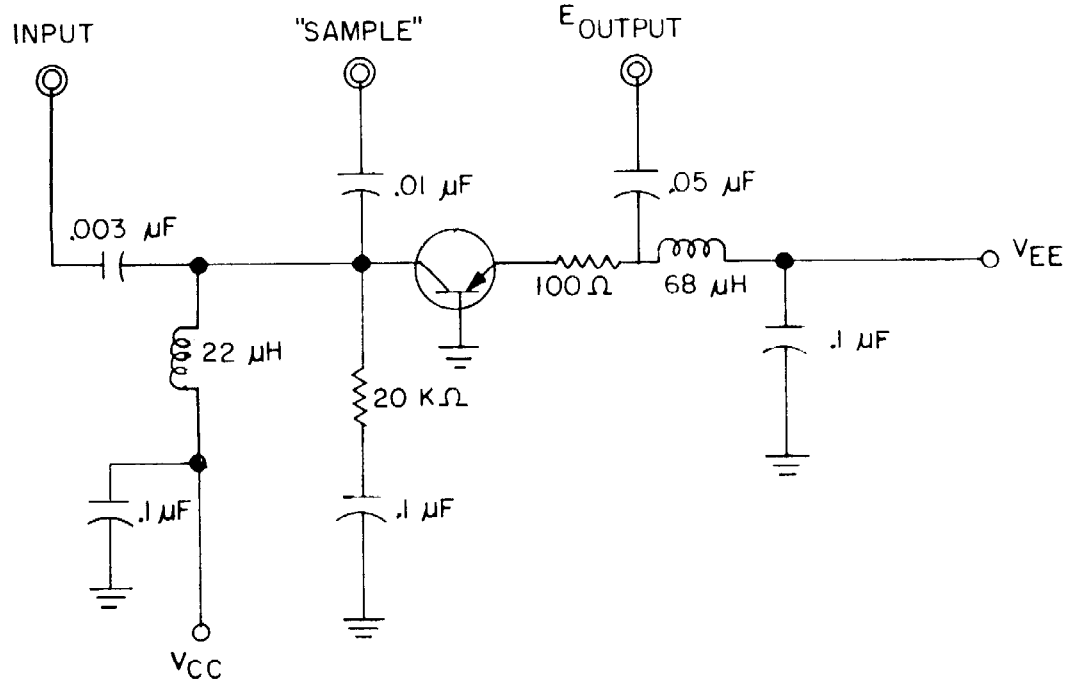
Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
Subgroup 1			20				
Physical dimensions	2066	(see figure 1)		---	---	---	---
Subgroup 2			15				
Solderability	2026			---	---	---	---
Thermal shock (temperature cycling)	1051	Test cond. C, except T(high) = +140° C		---	---	---	---
Thermal shock (glass strain)	1056	Test cond. B		---	---	---	---
Moisture resistance	1021			---	---	---	---
End points:							
Collector to base cutoff current	3036	Bias cond. D; V_{CB} = -25 Vdc		I_{CBO}	---	-1.0	μAdc
Small-signal short-circuit forward-current transfer ratio	3206	V_{CB} = -6 Vdc; I_E = 1 mAdc		h_{fe}	15	---	---
Subgroup 3			15				
Shock	2016	Nonoperating; 1500 G, 0.5 msec; 5 blows in each orientation: X_1, Y_1, Y_2, and Z_1		---	---	---	---
Vibration, variable frequency	2056	10 G		---	---	---	---
Constant acceleration	2006	10,000 G; in each orientation: X_1, Y_1, Y_2, and Z_1		---	---	---	---
End points: (Same as subgroup 2)							
Subgroup 4			15				
Terminal strength (lead fatigue)	2036	Test cond. E		---	---	---	---
End points: Seal (leak-rate)	1071	Test cond. G or H for fine leaks; test cond. A, C, D, or F for gross leaks		---	---	$1x10^{-7}$	atm cc/sec

TABLE II. Group B inspection - Continued.

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
Subgroup 5			15				
Salt atmosphere (corrosion)	1041			---	---	---	---
End points: (Same as subgroup 2)							
Subgroup 6			7				
High-temperature life (nonoperating)	1032	T_{stg} = +140° C; time = 340 hours (see 4.3.4)		---	---	---	---
End points:							
Collector to base cutoff current	3036	Bias cond. D; V_{CB} = -25 Vdc		I_{CBO}	---	-2	μAdc
Small-signal short-circuit forward-current transfer ratio	3206	V_{CB} = -6 Vdc; I_E = 1 mAdc		h_{fe}	12	---	---
Subgroup 7			7				
Steady-state operation life	1027	T_A = +25° C; V_{CB} = -10 Vdc; P_T = 150 mW; time = 340 hours (see 4.3.4)		---	---	---	---
End points: (Same as subgroup 6)							

TABLE III. Group C inspection.

Examination or test	MIL-STD-750		LTPD	Symbol	Limits		Unit
	Method	Details			Min	Max	
Subgroup 1			λ = 10				
High-temperature life (nonoperating)	1031	T_{stg} = +140° C (see 4.3.4)		---	---	---	---
End points: (Same as subgroup 6 of group B)							
Subgroup 2			λ = 10				
Steady-state operation life	1026	T_A = +25° C; V_{CB} = -10 Vdc; P_T = 150 mW (see 4.3.4)		---	---	---	---
End points: (Same as subgroup 6 of group B)							



PROCEDURAL NOTES:

1. Connect 10 MHz source to Input jack.
2. Connect *RFVM to Sample jack**.
3. Adjust 10 MHz level so that 1.6 V is read on RFVM.
4. Insert transistor into socket, apply bias, and set 10 MHz level for a 1.59 V reading on RFVM.
5. Connect RFVM to Output jack, $r_b'C_c$ is read with 1 mV = 10 psec, 3 mV = 30 psec, etc., (the 1.59 Vin should be checked regularly during successive test measurements).

*RFVM = Boonton type 91CA or equiv; (high impedance); unterminated probe, Boonton type 91-6C adapter or equiv, to be used.

**Adapter BNC UG-491A/U, or equiv, to be used for connections to Input, "Sample", and Output jacks.

FIGURE 4. Collector-base time constant test circuit (an equivalent circuit may be used).

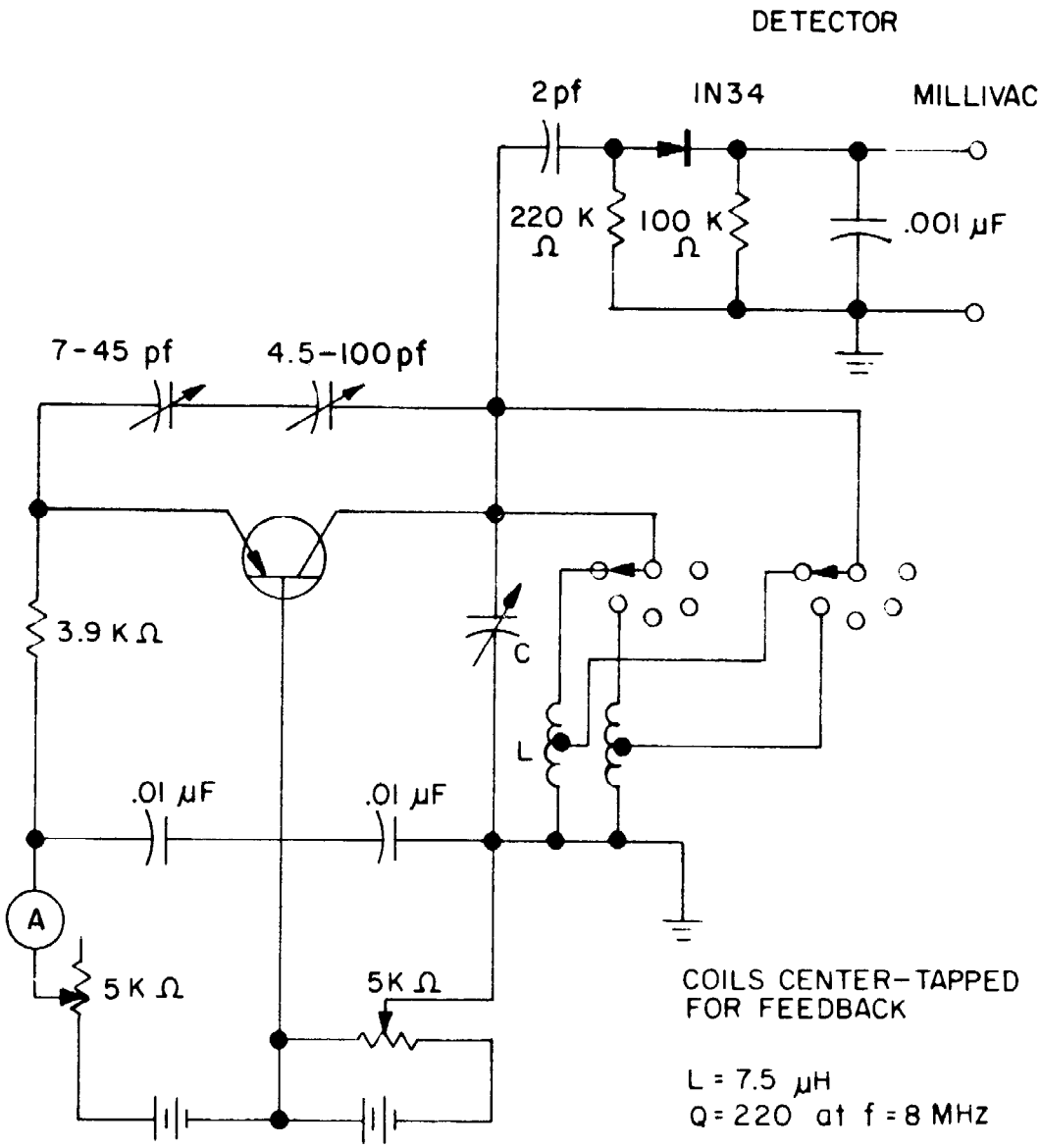


FIGURE 5. Maximum frequency of oscillation test circuit.

5. PREPARATION FOR DELIVERY

5.1 See MIL-S-19500, section 5.

6. NOTES:

6.1 Notes. The notes specified in MIL-S-19500 are applicable to this specification.

6.2 Ordering data. Procurement documents should specify the following:

Terminal-lead length if other than as specified in figure 1 (see 3.3.1).

Custodians:
Army - EL
Navy - EC
Air Force - 17

Review activities:
Army - MU, MI
Navy - SH
Air Force - 11, 85
DSA - ES

User activities:
Army - SM
Navy - CG, MC, OS, AS
Air Force - 13, 15, 19, 70, 80

Preparing activity:
Army - EL

Agent:
DSA - ES

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